

WATER SENSITIVE URBAN DESIGN IMPLEMENTATION FRAMEWORK FOR DARWIN DISCUSSION PAPER

FINAL

Prepared for the Northern Territory Department of Planning and Infrastructure
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Executive Summary

In order to manage the impacts to Darwin Harbour, particularly from new development and re-development areas, the Territory has identified that the implementation of water sensitive urban design (WSUD) on all new development zones is critical. To assist in the adoption of WSUD, the DPI (Department of Planning and Infrastructure) in conjunction with NRETA (Department of Natural Resources and Environment) have secured a grant from the commonwealth Coastal Catchments Initiative (CCI) program to develop a **WSUD Strategy for Darwin Harbour**. The Strategy is to create an enabling environment to ensure commitment to urban water cycle and stormwater management through the development of a WSUD framework linking policy to locally relevant technical design guidelines, manuals and industry tools. Development of the Strategy represents a substantial project.

This discussion paper builds on the research into barriers and opportunities for WSUD (documented in the *WSUD Barriers and Opportunities in Darwin Discussion Paper*), and presents a range of responses to help overcome key barriers. The responses include policy and planning frameworks, technical guidelines and tools and decision support tools.

This discussion paper provides commentary on WSUD implementation in other Australian states, including:

- Policy and planning frameworks
- Technical guidelines and tools
- Decision support tools
- Implementation programmes

The paper also broadly suggests a way forward for the Darwin Region, in the form of a WSUD implementation “road map”.

The paper is provided to initiate further discussion of WSUD implementation in the Darwin Region. Feedback on the discussion paper will be sought from stakeholders in order to refine the road map and finalise the mix of policy, planning, technical and decision support elements that will form part of the implementation programme.

One of the next steps in this project will be a series of in-depth interviews with key stakeholders, which will allow an assessment of the needs of local users and gaps in current application of WSUD. The outcomes of this assessment can then be used to build on this discussion paper and tailor the development of a policy and planning framework for WSUD, technical guidelines and decision support tools to be delivered through this project.

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1 INTRODUCTION

1.1 Background and Purpose for this Discussion Paper

Urban development in the Darwin Region is occurring without appropriate management of its impact on the urban water cycle and the health of the region's waterways.

WSUD (Water Sensitive Urban Design) is a new approach that addresses deficiencies in traditional development practice. However, WSUD can only be implemented effectively when there is a good policy and planning framework. This Discussion Paper reviews the current policy and planning framework, and proposes a new framework to achieve better outcomes for the region's waterways.

In order to manage the impacts to Darwin Harbour, particularly from new development and re-development areas, the Territory has identified that the implementation of water sensitive urban design (WSUD) on all new development zones is critical. To assist in the adoption of WSUD, the DPI (Department of Planning and Infrastructure) in conjunction with NRETA (Department of Natural Resources and Environment) have secured a grant from the commonwealth Coastal Catchments Initiative (CCI) program to develop a **WSUD Strategy for Darwin Harbour**. The Strategy is to create an enabling environment to ensure commitment to urban water cycle and stormwater management through the development of a WSUD framework linking policy to locally relevant technical design guidelines, manuals and industry tools. Development of the Strategy represents a substantial project as defined by the Workplan provided in Table 1 below.

This discussion paper has been developed as part of Task 8 (Stage 3) of the Workplan. It is intended to facilitate discussion on the framework that will be used in the Darwin Region to support the implementation of WSUD. A robust framework for WSUD implementation should include the following elements:

- A policy for WSUD in the Darwin Region, including a definition of WSUD, guiding principles, objectives and targets
- Technical guidelines and tools, including decision-support systems, to support the design process and allow the formulation of site-specific strategies to meet the objectives and targets
- A programme to implement the policy, make technical information available and support practitioners in their uptake of WSUD in the region. This may include training, workshops and other information-sharing sessions

The discussion paper includes a draft implementation framework for WSUD in the Darwin Region, in the form of a "road map" of these elements (currently being prepared). This road map will contribute to Task 11 in Stage 4 of the Workplan. Task 11 will expand on the road map and detail the implementation framework for WSUD in the Darwin Region. Stakeholder consultation (Task 6) and investigation into barriers (Task 9) will also contribute to detailing the implementation framework in Task 11.

Once the implementation framework is in place, it will inform the following stages of the project.

Table 1: WSUD Strategy for Darwin Harbour - Workplan

STAGE	TASK #	Activity
1	1	Refine workplan
	2	Establish project working group.
2	3	Develop WSUD Strategies for case studies in suitable format for communication and identify case studies for sub-catchment scale application of WSUD treatment train. <ul style="list-style-type: none"> • <i>WSUD Showcase - Bellamack residential sub-division conceptual WSUD Strategy is complete</i> • <i>Design development of Bellamack WSUD Strategy is about to commence (see Task below)</i>
	4	Identify potential WSUD objectives for Darwin <ul style="list-style-type: none"> • <i>Stakeholder workshop held on 14th and 15th June 2007</i> • <i>WSUD Objectives for Darwin - Discussion Paper (EDAW, Oct 2007)</i>
	5	Critical Analysis of WSUD/Stormwater Treatment Options for Darwin <ul style="list-style-type: none"> • <i>Stakeholder workshop held on 14th and 15th June 2007</i> • <i>Water Sensitive Urban Design Stormwater Treatment Options For Darwin - Discussion Paper (EDAW, Oct 2007)</i>
3	6	Prepare a stakeholder communication and consultation strategy (including establish website, fact sheets, presentations). <i>About to commence in collaboration with WQPP</i>
	7	Prepare and communicate a definition of WSUD within Darwin <i>About to commence in collaboration with WQPP</i>
	8	Review and report on policy, programme, technical and decision-support systems for WSUD in Australia (including any barriers to uptake of WSUD and respective jurisdictional responses). About to commence in collaboration with WQPP
	9	Identify potential barriers to uptake of WSUD in the NT. Develop strategy to address barriers. <i>Much of this work is complete as part of the Darwin Harbour Regional Plan of Management and WSUD projects elsewhere in Australia. This is to be summarised in a discussion paper. If the Working Group identify the need to further define the barriers a stakeholder workshop and interview process will be undertaken.</i>

STAGE	TASK #	Activity
4	10	Develop WSUD Strategies for case studies in suitable format for communication and identify case studies for sub-catchment scale application of WSUD treatment train. <i>WSUD Showcase - Complete design development of the Bellamack WSUD Strategy</i> <i>Identify and scope work associated with "retrofit" WSUD case study</i>
	11	Prepare detailed workplan for development of NT WSUD policy, objectives, design manual, performance standards and decision-support tools.
5	12	Prepare draft NT WSUD policy and objectives for Darwin including understanding existing legislation, workshops etc.
	13	Assess application of WSUD objectives and management practice options across a range of development situations and/or catchment-scale treatment-train & confirm set of objectives.
	14	Undertake consultation of draft WSUD policy and WSUD objectives to stakeholders and barriers to WSUD.
6	15	Define requirements of WSUD Guidelines and Tools (workshop to define design needs in detail and assess whether exiting guidelines satisfy this need)
	16	Document Draft WSUD Guidelines and Tools in including High Level and Conceptual Design Guideline, Technical Design Guideline and Design Tools (MUSIC Guidelines, Deemed to Comply Solutions, Standard Drawings etc.)
	17	Prepare Draft WSUD decision support tools for Darwin Harbour, consistent with WQPP, linking policy, objectives and guidelines
7	18	Undertake stakeholder consultation of WSUD Policy, WSUD design manual and performance standards, and decision support Tools and seek approval.
	19	Finalise WSUD design manual, decision support tools and performance standards
8	20	Seek NT Government approval for WSUD Policy, WSUD design manual and performance standards and decision support tools.
	21	Develop and publish stormwater management plans for key subcatchment in Darwin to illustrate application of WSUD Policy/Framework, design manual and decision support tools.
9	22	Develop an implementation strategy for incorporating policies and provisions for WSUD within NT planning policies, strategic plans and development approval processes as well as local government instruments
	23	Ongoing communication and website management
	24	Capacity Building and Training including government, local authorities, developers and industry practitioners
10	25	Incorporate policies and provisions for WSD into NT government planning policies, strategic plans and development approval processes, as well as relevant local government instruments. Implement agreed strategy to address barriers to uptake of WSD.

1.2 Defining Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design (WSUD) is an holistic approach to the planning and design of urban development that aims to minimise impacts on the natural water cycle and protect the health of aquatic ecosystems. It promotes the integration of stormwater, groundwater water supply and wastewater management at the development scale. The principles of WSUD are to:

- Protect existing natural features and ecological processes;
- Maintain natural hydrologic behaviour of catchments;
- Protect water quality of surface and ground waters;
- Minimise demand on the reticulated water supply system;
- Minimise wastewater discharges to the natural environment; and
- Integrate water into the landscape to enhance visual, social, cultural and ecological values.

WSUD is a nationally recognised term, and may be viewed as integrating the holistic management of the urban water cycle into the planning and design of the built form of an urban development. WSUD adopts a planning and design approach that integrates multiple opportunities into the built form of individual allotments, streets, suburbs and even master planned communities or precincts.

This Discussion Paper has its focus primarily on the Policy and Planning Framework to directly support the first three principles that relate to natural catchment hydrology and stormwater management aspects of WSUD. Notwithstanding this, the recommendations put forward will, by association, provide an improved policy and planning framework for the other aspects of WSUD.

1.3 WSUD objectives

Based on a workshop involving industry experts and local planners, researchers and practitioners, a preliminary suite of WSUD design objectives suitable for application in the Darwin Region have been developed. The proposed design objectives, summarised in Table 2, below have been tested at a preliminary level to establish the feasibility of complying with the design objectives.

Table 2: Summary of Preliminary WSUD Objectives

WSUD Objective	Performance Measure/Target
Stormwater Quality	Stormwater discharged from development areas to be treated in accordance with best practice: <ul style="list-style-type: none"> • 75% reduction in the mean annual load of Total Suspended Solids (TSS) • 60% reduction in the mean annual load of Total Phosphorus (TP) • 45% reduction in the mean annual load of Total Nitrogen (TN) • 90% reduction in the mean annual load of Gross Pollutants
Waterway Stability	<u>It is recommended this waterway stability objective is not adopted at this stage.</u> Further technical investigation is required to refine and test the practicality and achievability of the objective.
Potable Water Conservation	No quantitative potable water conservation objective has been specified. Rather than mandating a water conservation objective, education and incentives schemes will be adopted which focus on: <ul style="list-style-type: none"> • Reducing the garden irrigation demand for potable water by adopting low water use landscapes in public parks and encouraging low water used gardens on private allotments. • Reducing the indoor demand for potable water through the adoption of mandatory dual flush toilets and the adoption of water efficient fixtures and appliances • Maximising the use of treated wastewater and groundwater for non-potable end uses, in particular landscape irrigation which constitutes 65% of residential water demand.

WSUD Objective	Performance Measure/Target
	In support of the above initiatives, Territory Government and Power and Water are currently working with the SaveWater Alliance to establish a water conservation program.

It is recommended that the preliminary stormwater quality design objective be adopted at the earliest possible time as an interim design objective to ensure that stormwater pollution impacts of current urban expansion on Darwin Harbour are adequately addressed.

1.4 Where does WSUD apply?

WSUD can be applied within “greenfield” developments and “retrofitted” into existing urban areas. “Greenfield” development refers to urban development on a parcel of land not previously developed beyond agricultural or forestry uses. The term “retrofit” usually applies when WSUD approaches are implemented to replace and/or augment an existing system in an existing urban area (e.g. installation of a rainwater tank to divert and capture roof run-off before it enters a stormwater drain). Some WSUD retrofit approaches might be implemented during infill development, though WSUD retrofit can also occur independently of land development (e.g. as part of a stormwater management or waterway rehabilitation program).

WSUD principles apply at the individual development scale, where the development may range from a single allotment to a master-planned community. WSUD can also play a key role in meeting the principles of ecologically sustainable development because it seeks to optimise the use of water as a resource and keep the impacts of urban land use within ecologically sustainable limits.

1.5 Why is WSUD Important for the Darwin Region?

The aquatic environment of the Darwin Harbour provides many key uses and values for the community of Darwin (NRETA, 2005). It is a recreational resource, provides significant amenity to the region and underpins economic activity. Importantly the harbour represents the key aquatic ecosystem of the region providing habitat for a range of estuarine and freshwater flora and fauna. For example 27,350ha of mangrove forest is found in Darwin Harbour which constitutes approximately 5% of the total mangrove area of the Northern Territory.

The Harbour is the ultimate receiving environment for all stormwater and wastewater discharge from Darwin and Palmerston urban areas which support a population of approximately 110,000 people. Recent research has identified that although the harbour is considered to be in pristine condition with good water quality, the impacts of urban stormwater runoff and wastewater discharges are evident. Wastewater discharges are resulting in localised degradation within the estuarine tributaries of the harbour and during the wet season, stormwater runoff from urban areas is resulting in high loads of sediments, nutrients and heavy metals entering local waterways.

Current predictions for 2050 are that the Darwin Harbour region will experience strong population growth with an expectation of the need for an additional 50,000 to 100,000 new dwellings over this period. Given these large development pressures facing the Darwin Region, and the potential impact this will have on these pristine receiving systems within Darwin Harbour, the Territory has identified that a coordinated strategy is required for managing the Harbour.

In order to manage the impacts to Darwin Harbour, particularly from new development and re-development areas, the Territory has identified that the implementation water sensitive urban design (WSUD) on all new development zones is critical.

1.6 Outline of Discussion Paper

Policy, programme, technical and decision-support systems work together to support the implementation of WSUD, and need to be considered together as a holistic framework. However in order to discuss their particular roles, this document is divided into sections as follows:

- **Section 1** provides the context and purpose of the Discussion Paper

- **Section 2** discusses the key barriers to WSUD implementation that have been found elsewhere in Australia, and describes how policy, technical and programme responses can overcome these common barriers
- **Section 3** discusses the local context within which WSUD needs to be implemented in the Darwin Region, including institutional roles and existing programmes in the region
- **Sections 4** discusses **policy and planning** frameworks employed elsewhere in Australia to support the adoption of WSUD
- **Section 5** discusses **technical guidelines and tools**, including key examples of tools and resources available at a national level and within each state to support the WSUD conceptual and detailed design process
- **Section 6** discusses **decision support tools** for WSUD, including one key example from SEQ
- **Section 7** discusses some key examples of **programmes** that are being used to support the adoption of WSUD around Australia
- **Section 8** puts forward a “road map” (currently being prepared) showing a potential framework for implementation of WSUD in the Darwin Region.

2 ENABLING WSUD IMPLEMENTATION

Assessments by three other CCI projects in South East Queensland, NSW Lower North Coast, and Botany Bay (NSW), have shown that there are a range of barriers to the implementation of WSUD (Water by Design 2005, Walkerden 2007, and McManus and Morison 2008 respectively). These barriers are further discussed on the report on WSUD barriers prepared as a component of this project and have been grouped into the following themes:

- *Policy and Planning barriers:*
 - A policy paradox - whilst the state government controls the planning regulations and instruments, there is a lack of policy leadership evidenced by no formal policy, limited guidelines, regulations and administrative procedures.
 - Lack of consistency between local governments on the policy provisions and application of WSUD.
 - Poor administrative integration between agencies and councils, as well as between departments within local councils, to implement WSUD.
 - Limited councillor and senior staff commitment to WSUD.
- *Technical and knowledge barriers:*
 - Cost concerns for building, maintaining and replacing WSUD-related infrastructure by private industry and government that are couched within the 'affordable housing' viewpoint.
 - Lack of awareness by stakeholders and the community about the benefits and practicalities of water sensitive urban design, and lack of suitable training programs and access to relevant information.
 - Lack of consumer demand for water sensitive design developments, and lack of appropriate marketing about their costs, benefits and rewards.
 - Limited quantification of the benefits of WSUD in terms of initial costs and maintenance.
 - Little regional and local data on water quality parameters for MUSIC and other modelling tools to design WSUD systems.

To further quantify the barriers to WSUD implementation Chapter 5 of Australian Runoff Quality provides guidance on the series of key factors which influence the capacity of an organisation to implement WSUD (Brown et al 2006). These key factors include knowledge building, professional development, organisational strengthening, directive reforms and facilitative reforms as outlined in Table 3. It is noted that focusing efforts in one area such as teaching officers new skills does not necessarily overcome obstacles in intra- and inter organisational issues, nor does it develop and sustain the capacity of an organisation to undertake WSUD (Brown and others 2006). Rather a holistic approach is needed whereby WSUD is addressed across the organisation or region.

Table 3 Summary of capacity building themes and interventions (Brown et al 2006).

Capacity Building Theme	Capacity Building interventions
Knowledge building	<ul style="list-style-type: none"> • Knowledge of performance and cost of water management measures • Knowledge of social acceptance / expectations with respect to urban water management practices and designs • Knowledge of natural resources in the region • Knowledge of water governance issues and research • Knowledge / skills of professions dealing with water in the region • Knowledge of technical assessment tools to support water management decisions • An ongoing, coordinated R&D program
Professional development	<ul style="list-style-type: none"> • Technical knowledge and skill development • People Skill development
Organisational strengthening	<ul style="list-style-type: none"> • Political and managerial commitment • Reform of legislation, organisational structures and key processes to clarify responsibilities and efficiently deliver WSUD • Cultural management • Fostering champions / leaders • Improvements in inter-agency structures, networks and collaboration

Capacity Building Theme	Capacity Building interventions
Directive reforms	<ul style="list-style-type: none"> • Establish clear policy statement, regulations and standards • Using design objectives and technical guidelines • Adopting enforcement strategies
Facilitative reforms	<ul style="list-style-type: none"> • Mobilising community and political support • Creation of adequate funding mechanisms, financial resources and incentive structures • Using market based instruments • Providing organisational incentives • Using cross-stakeholder networks and stakeholder participation • Improving the way information is managed and shared. • Ensuring accountability for peoples actions • Auditing and reporting performance • Providing conflict resolution resources to stakeholders

As can be seen in Table 3 and the findings of the other CCI projects there is consistency in the findings. Linking the two bodies of research policy and planning issues relate to the themes in Table 3 of “directive and facilitative reforms” and “organisational strengthening”, and include establishing clear policy, objectives, securing commitment and ensuring consistency between organisations.

Technical and knowledge issues relate to knowledge, skills, and resources that people have to implement appropriate WSUD measures to match both their current skill level and the local environment. These issues are listed as technical skills, knowledge gaps, having appropriate guidelines.

This document builds on these themes identifies policy and planning frameworks, technical guidelines and tools and decision support tools that current exist throughout Australia that seek to implement WSUD. These themes are discussed in sections 4, 5 and 6 respectively. WSUD programs that have been developed to assist the implementation of WSUD are discussed in Section 7. It should be noted that the effective implementation of WSUD in Darwin will relate to a series of these factors, which should to be determined through an assessment of the needs of local users and gaps in current application of WSUD. The outcomes of any such assessment can then be used to tailor the development of programs, technical guidelines and decision support tools to be delivered through this project.

3 DARWIN REGION CONTEXT

The implementation framework for WSUD in the Darwin Region needs to fit within the context of the existing administrative and legislative framework, and needs to complement existing policies and programmes relating to stormwater management, catchment management and receiving waterways in the region.

This section presents a desktop review of the administrative and legislative framework for water management in the NT and outlines key policies and programmes relevant to WSUD. This review is to be refined and ground truthed through further investigation undertaken as part of the stakeholder consultation process (Task 6) and as part of Task 12 (see the Workplan in Table 1).

3.1 Administration

The Northern Territory Department of Natural Resources, Environment and the Arts (NRETA) is responsible for environmental management in the Darwin Region. NRETA includes a new Environment Protection Authority (EPA), which commenced in early 2008. NRETA and the EPA have a broad role in land and water resource management.

The Darwin Harbour Advisory Committee oversees the implementation of the Darwin Harbour Regional Plan of Management, and therefore has a strategic role in stormwater management.

Operational management of stormwater is undertaken by both the Territory and local governments, with road corridors and crown lands managed by the NT government, while other public lands are generally managed by the local governments. Within the Territory government, it is the Department of Planning and Infrastructure's (DPI's) Land Administration, Land Development, Road Network and Infrastructure Project units who have primary responsibility for stormwater management activities. Local governments are the approving authorities for stormwater drainage works. Six local governments are located within the Darwin Harbour region: Darwin City Council, Palmerston City Council, Litchfield Shire Council, Cox Peninsula Community Government Council, Belyuen Community Government Council and the Coomalie Community Government Council. Darwin and Palmerston City Council areas contain the urban areas of Darwin and Palmerston, and it is in these jurisdictions that most land development is occurring.

Planning and land development are the responsibility of the DPI. The Development Consent Authority (DCA) is a division of the DPI. Local government has a role in advising the DCA, but otherwise its primary development responsibilities are road and drainage for sub-divisions.

3.2 Legislation

Relevant information on the legislative framework was sourced from the Draft Stormwater Management Strategy for the Darwin Harbour Catchment (Northern Territory EPA, March 2006).

The *Water Act* and the *Waste Management and Pollution Control Act* are the main legislative instruments governing stormwater management in the Northern Territory:

- The *Water Act* governs the use of water, including surface and groundwater. The *Water Act* allows Beneficial Use Declarations to be made in relation to particular water bodies. A Beneficial Use Declaration defines the environmental values that apply to the body of water, and associated water quality objectives. Beneficial Use Declarations have been made for Darwin Harbour, including aquatic ecosystem protection, recreational water quality and aesthetic environmental values.
- The *Waste Management and Pollution Control Act* governs stormwater pollution. Activities with the potential to cause environmental harm are regulated under this Act.

Other relevant legislation includes the *Planning Act* and the *Local Government Act*. The *Planning Act* governs new development. Under the *Planning Act*, the Development Consent Authority can place conditions on new developments, including stormwater management conditions. Local Government also have some stormwater management responsibilities under the *Local Government Act*.

3.3 Policies and programmes

The Darwin Harbour Regional Plan of Management and the Draft Stormwater Management Strategy for the Darwin Harbour Catchment establish the initial elements of a framework for managing the water quality impacts to the Harbour. Additionally, a Water Quality Protection Plan (WQPP) is being developed for Darwin Harbour Catchment. The WQPP is a jointly funded project with the Australian Government, through the Coastal Catchments Initiative (CCI), aimed at identifying and addressing key water quality risks to the values of the Darwin Harbour and its catchment. The WQPP is being developed over a three year period and the Department of Natural Resources, Environment and the Arts (NRETA) has primary responsibility for the development of the plan.

3.3.1 Darwin Harbour Regional Plan of Management

The Darwin Harbour Regional Plan of Management includes five goals and a number of strategies relevant to WSUD. The components relevant to WSUD have been summarised in Table 2.

Table 2: Components of the Darwin Harbour Regional Plan of Management that are partially addressed by a WSUD strategy

Goals	Outcomes	Strategies directly relevant to WSUD
To maintain a healthy environment	Improved understanding and knowledge of the region's environment	<ul style="list-style-type: none"> Improve understanding of the environment and potential impacts to it
	Protection and enhancement of freshwater, estuarine and marine water quality	<ul style="list-style-type: none"> Manage stormwater discharge to Darwin Harbour to minimise impacts on water quality Manage sewage effluent discharge to Darwin Harbour to minimise impacts on water quality Manage clearing and reclamation activities, and protect coastal and riparian habitats to ensure water quality is maintained
	Protection of the health and functioning of ecosystems and conservation of biodiversity	<ul style="list-style-type: none"> Identify and protect significant species, ecosystems and biodiversity Minimise the impact of pollution on ecosystems and biodiversity Minimise the impacts of land clearing and development on ecosystems and biodiversity Minimise impacts on ecosystems and biodiversity from modified catchment hydrology and harbour hydrodynamics
To support recreational use and enjoyment of the environment	Protection and enhancement of recreational amenity and opportunity	<ul style="list-style-type: none"> Manage risks to enable water based recreation
	Ecologically sustainable harvesting and fishing	
	Protection of the diverse range of aesthetic values of the Darwin Harbour Region	<ul style="list-style-type: none"> Improve, maintain and protect aesthetic values of the Darwin Harbour region
To encourage ecologically sustainable development	Effective planning and management of future development	<ul style="list-style-type: none"> Ensure the legislative framework supports long term development within the Darwin Harbour region Ensure effective environmental management of development

Goals	Outcomes	Strategies directly relevant to WSUD
	Support of sustainable economic development	<ul style="list-style-type: none"> • Ensure development is ecologically sustainable • Publicise ecologically sustainable development and practices
	Ecologically sustainable use of fresh water in the Darwin Harbour region	<ul style="list-style-type: none"> • Allocate fresh water for ecologically sustainable use
To protect cultural values and heritage	Management of cultural, spiritual and heritage values	
To foster community ownership and participation in management	Increased public awareness and communication of environmental, social and economic values and issues	
	Improved public participation in management and monitoring	

3.3.2 Stormwater Management Strategy for the Darwin Harbour Catchment

The Draft Stormwater Management Strategy (SMS) for the Darwin Harbour Catchment establishes a framework for stormwater management planning in the region. The SMP calls for Stormwater Management Plans to be prepared for individual subcatchments in the Darwin Harbour region:

“Stormwater in the Darwin Harbour Catchment will be managed by comprehensive, catchment based Stormwater Management Plans that optimise the protection of property, sustain ecosystems and ensure public health and safety.”

The Draft SMS recognises six types of impacts that urban development has on receiving waterways:

1. Catchment hydrology (frequency and intensity of runoff and flood events)
2. Water quality (suspended solids, nutrients, micro-organisms, heavy metals and organic materials)
3. Waterway channel form (increased erosive flows, removal of riparian vegetation, sedimentation)
4. Riparian vegetation (habitat and bank stability impacts)
5. Aquatic habitats (through changes in geomorphology, removal of snags, loss of vegetation, drainage of wetlands and floodplains)
6. Watercourse barriers and constrictions (bridges and culverts)

The Draft SMS calls for several actions, some of which can be addressed by a WSUD Strategy:

- Develop guidance materials/codes of practice outlining methods of minimising pollution to stormwater
- Develop, implement and maintain public awareness of best practice in stormwater management

3.3.3 Water Quality Protection Plan

The Water Quality Protection Plan (WQPP) is an element of the Darwin Harbour Regional Plan of Management, prepared by the Darwin Harbour Advisory Committee. The Water Quality Protection Plan will include (NRETA website):

- A statement on the environmental and cultural values of Darwin Harbour which translates into Beneficial Uses Declarations under the *Water Act*.
- Water quality guidelines/objectives that translate these values into water quality concentrations and identify measurable biological condition indicators that can be monitored.
- Decision support tools. These are management tools to assist in decision making. The project will develop a water quality model for Darwin Harbour which can be used to predict the impact of nutrient and sediment inputs on the Harbour's water quality. The project will develop institutional capacity to use decision support tools.
- Regulatory mechanisms to achieve the objectives of the plan. For example guidelines for urban development for water sensitive urban design and best practice stormwater management.
- A monitoring and reporting system that informs resource managers and the public about the state of health of the Harbour and its catchment.

4 POLICY AND PLANNING FRAMEWORK

WSUD needs to be supported in the Darwin Region through appropriate policy and a strong position within the planning framework. The policy and planning framework should:

- Provide leadership from the Territory government to support the adoption of WSUD
- Include clearly stated WSUD design objectives
- Inform and guide strategic land use planning (i.e. structure planning and master planning), infrastructure planning and development assessment decision making
- Provide incentives for WSUD where appropriate

This discussion of policy and planning frameworks is partially based on a previous discussion paper prepared for the South East Queensland Healthy Waterways Partnership by Ecological Engineering and John Gaskell in 2006 (“Developing an Effective Policy and Planning Framework for Water Sensitive Urban Design (WSUD) in South East Queensland (SEQ)”).

A review of literature explaining the policy and planning frameworks adopted in other parts of Australia to support the effective adoption of WSUD was completed. South East Queensland, Victoria and NSW have all undertaken a reasonable level of assessment of their respective policy and planning frameworks in relation to its support of WSUD. Accordingly, the literature review has focused primarily on the work completed to date in these three states.

The literature review established the following guiding questions to focus the review effort:

1. Did state legislation (planning and environment) need to be amended to better support WSUD?
2. What state policies (planning and environment), if any, support the adoption of WSUD and did they need to be amended to provide/improve the level of support provided for WSUD?
3. What amendments were required to Local Planning Schemes to improve adoption of WSUD in new development (greenfield and infill)?
4. What other supporting codes/guidelines/tools have been developed (or have been identified as being necessary) to improve the successful delivery of WSUD on the ground?

4.1 Overview of the Australian Context

In Australia, the statutory and policy initiatives driving WSUD can be summarised as shown in Figure 1. At the Commonwealth level, the National Water Initiative (NWI) provides a clear national strategic action plan for the sustainable management of Australia’s water resources. In relation to WSUD it provides a clear intent to create Water Sensitive Australian Cities using the principles and practices of Water Sensitive Urban Design (Paragraph 92 of the Intergovernmental Agreement on a National Water Initiative). Specific actions under the NWI include:

- Development of national health and environmental guidelines for priority elements of WSUD (initially recycled water and stormwater) by 2005;
- Development of national guidelines for evaluating options for WSUD, both in new urban subdivisions and high rise buildings by 2006;
- Evaluating existing “icon” WSUD projects to identify gaps in knowledge and lessons for future strategically located developments by 2005 (status of this work unknown);
- Reviewing of the institutional and regulatory models for achieving integrated urban water cycle planning and management, followed by preparation of best practice guidelines by 2006; and
- Reviewing of incentives to stimulate innovation by 2006.

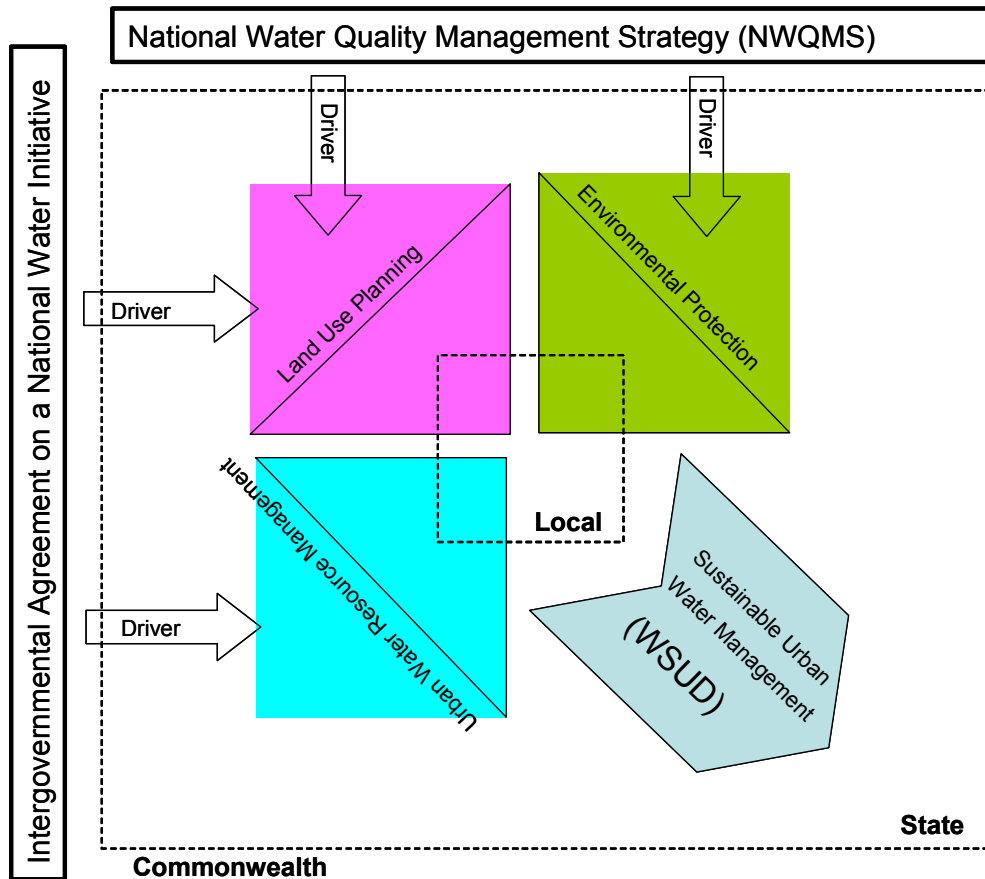


Figure 1: Statutory and policy initiatives driving WSUD in Australia

Also at the Commonwealth level, the Australian Guidelines for Urban Stormwater Management (ARMCANZ and ANZECC 2000), aims to provide a nationally consistent approach to the management of urban stormwater and in particular recommend all new urban development (Greenfield and infill) adopt WSUD principles.

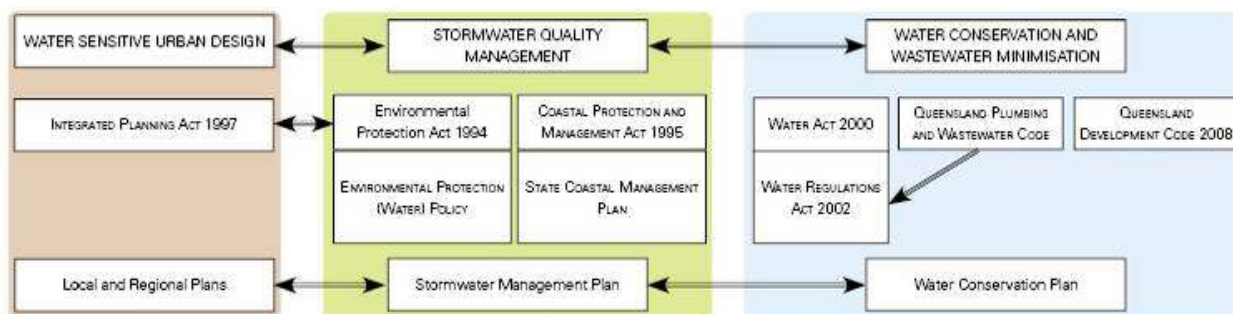
At the State level, planning and environmental legislation promotes the principles of Ecologically Sustainable Development (ESD) with state planning and environmental policy frameworks and their supporting guidelines providing the more specific standards and compliance guidance in relation to WSUD (primarily stormwater quality).

At the Local Government level, regional water resource management strategies supported by regional and/or local catchment scale integrated water cycle management plans and/or stormwater management plans provide the strategic context for WSUD. The local planning scheme provisions (e.g. policies, plans/overlays, codes) provide the regulatory control, while regional and/or local technical guidelines provide the consistency of approach by both regulators and designers.

4.2 The South East Queensland Approach

Urban water management in Queensland is governed by environmental protection policies, planning policies, and development codes. The interaction between the different codes in guiding urban water management and hence WSUD is illustrated in Figure 2.

Figure 2: Queensland planning policies related to urban water management State Policies for urban water management



State regulation of development in Queensland is governed by the Integrated Planning Act 1997 (IPA) and the Environmental Protection Act 1994 (EP Act). In July 1998, elements of the EP Act were integrated into the IPA, realising the dual purpose of the two acts in protecting Queensland's environment. Development is assessed through the integrated development assessment system (IDAS) under the IPA. The IDAS includes a development assessment process for both state and local agencies. The IPA requires regional and local plans to be developed to instate ecologically sustainable development objectives. Regional plans are required where development objectives can be managed through the coordination of two or more councils. The Council for Urban Management within the Department of Infrastructure and Planning is the administrator of local and regional development plans.

The requirement for stormwater management is articulated in the State Environmental Protection (Water) Policy (EPP (Water)). The EPP (Water) places jurisdiction on the local government in developing an environmental plan for stormwater quality management. The plan must ensure that stormwater is treated to a level consistent with water quality objectives for the relevant waters. Methods of reducing contamination in stormwater are stated in the policy, some of which are typical of WSUD strategies (for example, artificial wetlands). No additional requirements on water quality objectives are given in acts for specific receiving environments. For example, the State Coastal Management Plan developed under the Coastal Protection and Management Act 1995 references the EPP (Water) in defining stormwater quality objectives relevant to the values of the receiving catchment. The requirement for a LGA-based stormwater management plan is further articulated in the state interest planning policy for Queensland Waters (2000), with guidance provided by the EPA's document *Model Urban Stormwater Quality Management Plans and Guidelines*.

State based water quality objectives have not been set in Queensland. Environmental values and corresponding water quality objectives are defined for a given waterbody, of which the EPP (Water) defines 36 within Queensland. Environmental values for each waterbody are defined by the chief executor of the department in which the Water Act 2000 is administered and are generally characterised as:

- a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety (e.g. seagrass beds, aquatic ecosystems); or
- b) another quality of the environment identified and declared to be an environmental value under an Environmental Protection Policy or Regulation (e.g. drinking water, primary/secondary/visual recreation).

Corresponding water quality objectives are either numerical values or statements for indicators that protect a defined environmental value. Where a receiving environment is not defined in the EPP (Water) or water quality objectives for a defined waterbody are not stipulated, it is advised that water quality guidelines which protect all environmental values of the receiving environment be adopted. Water quality objectives are applicable to all developments, where development is defined as any building work (including repairs, alterations, moving or demolishing, and excavation work), plumbing or drainage work, operational work (for example, site configuration activities), reconfiguring a lot, and making a material change of use in premises.

The South East Queensland Regional Plan was developed under the requirements of the IPA (1997) to ensure development protects and improves the ecological health and water quality of surface and groundwater, including regional waters, estuaries, wetlands and Moreton Bay. The

SEQ Regional Plan is an integral part of the Water Sensitive Action Plan strategy, which involved five development stages:

1. Identify barriers to WSUD within SEQ
2. Improve capacity of council to guide, plan and assess WSUD
3. Develop total water cycle objectives to help guide performance criteria
4. Develop a regional plan
5. Develop WSUD technical guidelines to assist developers and consultants design WSUD elements.

The South East Queensland Regional Plan contains 12 policies. WSUD is identified within the policy *Desired Regional Outcome 11: Water Management* as key to minimising development impacts on the regions water cycle (section 11.5.4). Water conservation targets are stated within the policy, and tie into the Water Commissions water reduction targets for residential and commercial developments. Stormwater quality objectives are based on water quality guidelines for the receiving waterbody and are consequently catchment based. Regional design objectives for stormwater quality management, as well as waterway stability and frequent flow management are proposed as part of the Water Sensitive Action Plan, with implementation forecast for 2011. The proposed objectives are:

- *Stormwater Quality.* Load reduction in gross pollutants, TSS, TP and TN of 90%, 80%, 60% and 45%, respectively. The design objectives are applicable to all developments excluding those with an impervious area less than 25% or those that capture and manage the first 10mm of runoff each day from all impervious areas.
- *Waterway Stability.* Post development peak flows for the 1yr ARI discharge event to be limited to pre-development peak 1yr ARI discharge event where the discharge is directed to an unlined channel or non-tidal waterway or wetland.
- *Frequent Flow Management.* Capture and manage the first 10mm or 15mm of run-off for developments with an impervious area between 0 and 60%, or greater than 60% respectively.

The Water Sensitive Action Plan together with the development of the South East Queensland Regional Plan has been administered through the SEQ Healthy Waterways Partnership. The Healthy Waterways Partnership was established in 2001 external to government to provide collaboration between government, industry, the community and researchers in meeting the individual expectations for waterway health in South East Queensland.

4.3 The Victorian Approach

In Victoria, all elements of WSUD - water, wastewater and stormwater - are integrated in Victorian planning policy, for example, Melbourne 2030 Greener City initiatives and their translation into Clause 12.07 of the Victoria Planning provisions, precinct planning guidelines and growth area strategies.

The Victoria Planning Provisions recently delivered the first detailed implementation of water sensitive urban design through the Clause 56.07 Integrated Water Management requirements. From 9 October 2006, urban land developers across the State seeking subdivision approval to create two or more lots from a single title must design to the Clause 56.07 requirements.¹ Water, sewer and drainage services must incorporate water conservation, wastewater recycling and stormwater reuse (as required by servicing authorities), flood mitigation and stormwater quality treatment of runoff.

The Department of Sustainability and Environment issued a practice note to assist implementation of the integrated water management provisions. The provisions are expected to accelerate

¹ Although the new Clause 56.07 provisions came into operation on 9 October 2006, there is a transitional provision to manage planning permit applications that were lodged before that date.

knowledge transfer, grow expertise in the development industry and deliver benefits of stormwater quality, flow control, and stormwater harvesting for use in new housing estates.

In greenfield subdivisions and urban growth areas, individual lots are sold with services - including stormwater drainage - in a 'ready to build' state. As a general rule, no further planning approval is required for housing development. The next approval step will be the building approval. Lots approved under the Clause 56.07 provisions will have already met the Victorian stormwater quality standard. Lots approved under earlier residential subdivision regimes are not required to retrospectively meet the standard. If still vacant, they are unlikely to meet requirements for quality treatment when later developed.

In existing urban areas, urban consolidation policies encourage redevelopment to increase the number of dwellings per property. This typically increases site coverage and the amount of stormwater runoff generated. These developments are approved under Clause 55 of the Victoria Planning Provisions, which contain no specific stormwater quality requirements and are not required by approval authorities to meet the SEPP (Water of Victoria) requirement. The approved development is then usually subdivided for market sale. However, the Clause 56.07 provisions are unlikely to cover these developments. This is because subdivision of existing buildings is exempt from the requirements, and approved Clause 55 developments are treated by most approving authorities as existing buildings even when construction has not commenced.

The policy is supported by Melbourne Water who are responsible for most of the trunk drainage within Melbourne, as well as local government. Melbourne Water are active in controlling pollution, especially nitrogen into Port Phillip Bay and have constructed around 40 retarding basins as wetlands to remove stormwater pollution at a cost of \$60 million. It has incorporated water sensitive urban design elements, primarily wetlands, in the design of drainage schemes for greenfield development. As an adjunct to its core activities Melbourne Water is administering the Victorian Government Yarra Action Plan which identifies stormwater as the most significant source of pollution in the city's rivers creeks and wetlands. The \$20 million Stormwater Program seeks to tackle diffuse stormwater pollution, and increase institutional capacity for WSUD through local government.

WSUD Engineering Guidelines: Stormwater (Melbourne Water 2005) have been prepared by Melbourne Water to provide a consistent design and assessment approach for WSUD stormwater quality management infrastructure in Victoria. It is expected that these guidelines will be used by most councils and developers to prepare and approve stormwater quality infrastructure designs.

4.4 The New South Wales Approach

The adoption of WSUD in NSW is not enacted by any State legislation or policies. The *Environmental Planning and Assessment Act, 1979 (EP&A Act)* and the *Local Government Act 1993*, establish the framework within which planning and local government operate. The *EP&A Act* establishes a planning control framework that is driven from top down using State Environment Protection Policies (SEPPs) and Regional Environmental Plans (REPs) to set objectives, policies and requirements in respect of development having state or regional significance. The SEPPs and REPs guide the development of local planning instruments such as Local Environment Plans (LEPs) and Development Control Plans (DCPs) to achieve consistent outcomes. The main WSUD related SEPP is the BASIX scheme, which requires a 40% reduction in potable mains water use for all new residential developments and redevelopments.

Local Council are responsible for the development of LEPs which establish landuse and broad principles for development, while a councils DCP typically establishes objectives and targets for issues such as WSUD.

The *Local Government Act, 1993* requires councils in NSW to properly manage, develop, protect, restore, enhance and conserve the environment in a manner that is consistent with and promotes the principles of ESD. The *Local Government Act 1993* places a strong onus on local councils to prepare planning controls that improve the sustainable management of the urban water cycle.

To assist local government in their adoption of WSUD the NSW Department of Environment and Climate Change (DECC) is currently updating the Managing Urban Stormwater (MUS) Framework. The MUS Framework is a holistic suite of guidance documents and supporting "tools" aimed at

delivering strategic structural and non-structural responses from regional and local planning authorities in relation to sustainable management of urban stormwater. The MUS framework encapsulates the full hierarchy of guidance documents from high level management considerations through to detailed guidance for both the urban design and detailed technical design and implementation of WSUD techniques for both the construction and post-construction phases of urban development. An outline of the MUS framework is shown in Figure 3.

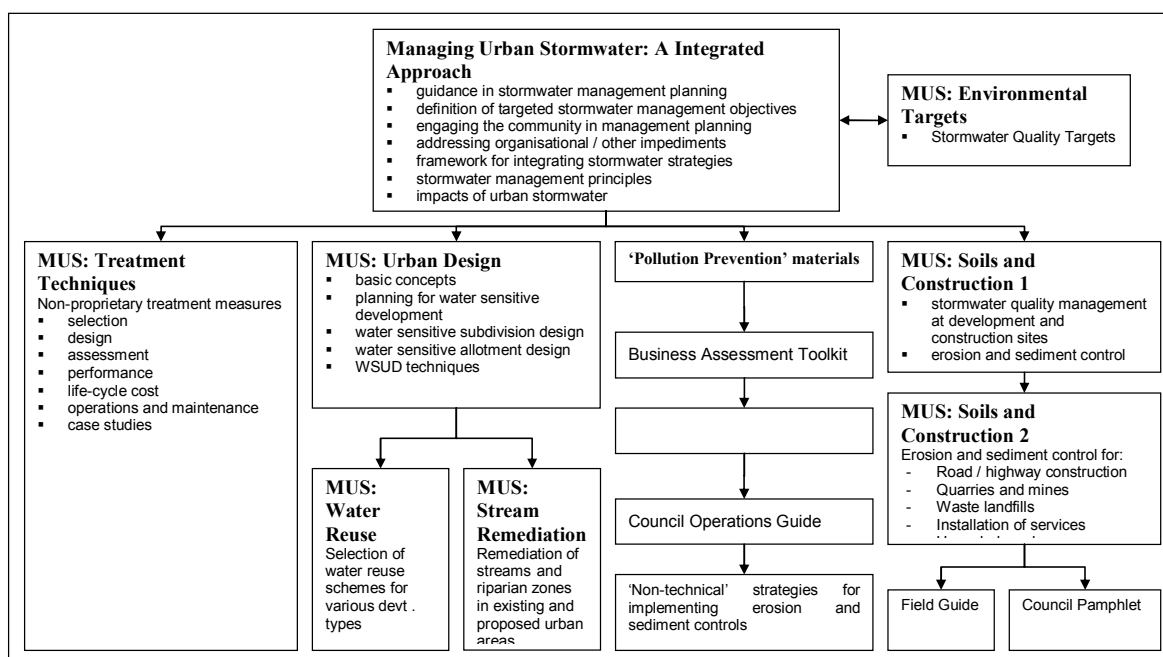


Figure 3: The Managing Urban Stormwater documents and tools (draft framework, 2007)

As local councils are responsible for the majority of the stormwater systems, it is local government who have greatest control over the implementation of WSUD. The lack of consistent policy and direction at the state level has resulted in some local councils developing their own WSUD objectives through their DCP, whereas other council have no such provisions. Again there is a lack of direction many councils provisions vary in the actual objectives and their application to different landuses. A recent investigation into the barriers and opportunities for WSUD in Sydney (McManus and Morison 2008), ranked the following strategies in order of preference as programs to be pursued by the state government and stakeholders:

1. Development of a WSUD DCP and supporting provisions/guidelines for Councils to facilitate the consistent implementation of WSUD in new developments throughout the catchment
2. Defining consistent WSUD Principles for insertion into each council's LEP template.
3. Securing Councillor awareness and commitment to WSUD. This could include Councillor awareness-raising through existing forums (e.g. floodplain management conferences)
4. Securing executive awareness and commitment to WSUD with targeted programs.

4.5 Policy Literature Review Conclusions

Key conclusions drawn from the literature review were:

- A State Planning Policy (or equivalent instrument) that explicitly supports adoption of WSUD is essential.
- Having clearly stated WSUD design objectives contained within a State Planning Policy and/or a State Environmental Policy or alternatively within a supporting document that is called up by a State Policy is important to ensure consistency and confidence in State and Local Government decision making on land use and development proposals.
- Preparation of local (or catchment scale) WSUD Plans is essential to inform and guide strategic land use planning (i.e. structure planning and master planning), infrastructure

planning and development assessment decision making. In other states these would be completed by Local Government Authorities and in the NT local government is responsible for approval of all stormwater drainage. In the local WSUD Plans could also tie in with the subcatchment Stormwater Management Plans required as part of the Stormwater Management Strategy. Subcatchment Stormwater Management Plans will be prepared by “Stormwater Management Planning Groups” (SMPGs), likely to include both NT and local government representatives.

- In other states, incentive instruments such as State Government Grants are used to assist/encourage Local Government to undertake preparation of municipal wide (or catchment scale) WSUD Plans. In the NT, incentives to the SMPGs may be appropriate.
- Preparation of “model” (i.e. example) WSUD planning scheme provisions (such as an “example” WSUD code) improves consistency in how local planning schemes deal with WSUD. In the NT, a model WSUD Plan/Stormwater Management Plan could be prepared.
- A “best practice” approach to urban stormwater quality management is preferred.

5 TECHNICAL GUIDELINES AND TOOLS

A key tool to enable widespread update of WSUD practices is technical information to translate water policies and targets into water management practices. Broad policies need to be translated into practical design guides and advice that are of direct relevance in a local context and which will enhance the knowledge, ability and confidence of developers, builders, planners and local council staff in water management options and techniques.

There are a wide range of technical documents that have been prepared in Australia at national, state, regional and local levels to support the implementation of WSUD. The range of information available can be daunting, therefore Figure 4 organises technical information into four basic types of documents, according to the scale and the stage of the planning and design process at which they are relevant:

1. **Framework documents**, which provide high-level information on the principles and practice of WSUD. An example is *Australian Runoff Quality* (Engineers Australia, 2006)
2. **Planning Guidelines**, which offer high-level advice on management and strategic issues, including WSUD objectives and targets. An example is the NSW *Managing Urban Stormwater* series of documents (published by DECC)
3. **Multi-disciplinary conceptual design information**, such as fact sheets, case studies, etc., which distil technical design information into a format that is readily understood by a broad non-technical audience. An example is the series of “Water by Design” Fact Sheets published by the SEQ Healthy Waterways Partnership
4. **WSUD Technical Design Guidelines**, which offer guidance on the detailed design of WSUD elements including stormwater treatment systems. For example, both Melbourne Water and the SEQ Healthy Waterways Partnership have published in-depth Technical Design Guidelines.

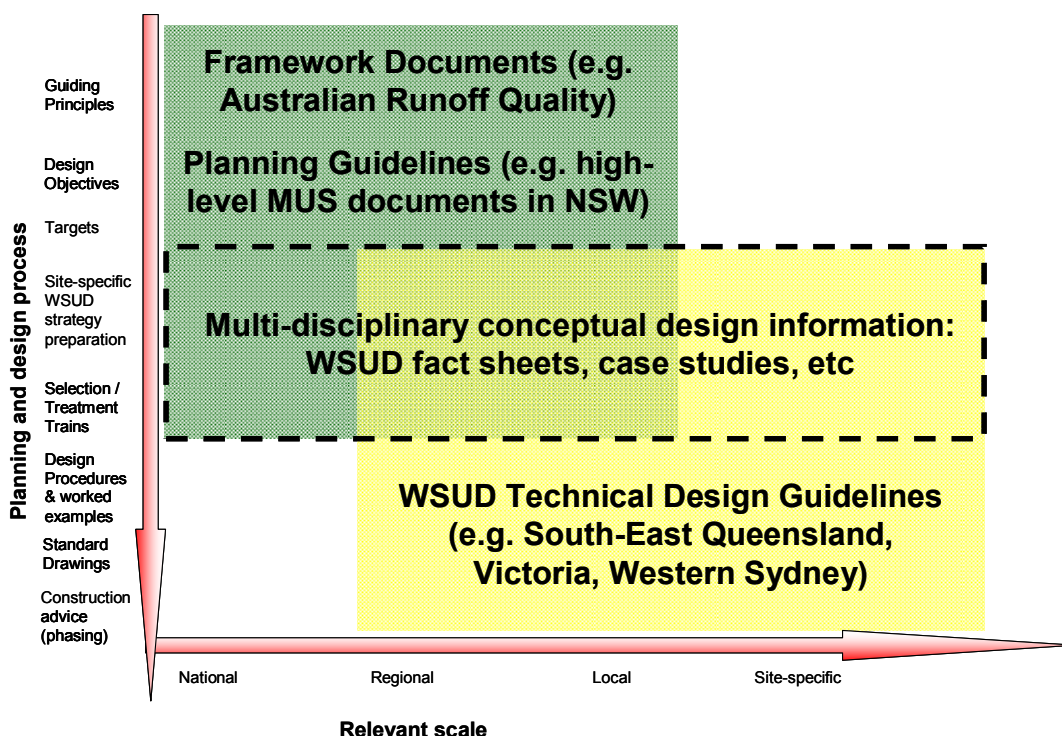


Figure 4: Hierarchy of technical information available to support WSUD

The hierarchy of technical documents is represented in another way in Table 3.

Table 3: Types of technical information available to support WSUD

Types	Scale	Examples	Purpose	Content	Audience
Framework Documents	National	National Water Quality Management Strategy	Strategic link between waterway environmental values and catchment management	Guidance on preparing catchment management strategies	Catchment managers
		ANZECC Guidelines	Overarching framework for water quality management	Receiving water quality objectives	Waterway managers
		Australian Runoff Quality	Policy and technical framework	Guiding principles for WSUD	Technical managers
Planning Guidelines	Regional	High-level MUS documents	Inform the local planning process	WSUD objectives Guidance on implementing WSUD at a local level	Strategic planners Environmental managers
Multi-disciplinary conceptual design information	Local	Wyong DCP, guidelines and tools	Inform the site planning and conceptual design process	Conceptual design approach relevant to local conditions and local authority requirements	Local government Developers Designers Landscape architects Engineers
Technical Design Guidelines	Site-specific	Melbourne Water/SEQ Technical Design Guidelines	Inform the design and construction process	Designs of stormwater treatment and other elements	Designers Landscape architects Engineers

At the broadest scale, framework documents such as the National Water Quality Management Strategy (NWQMS), the ANZECC Guidelines and Australian Runoff Quality (ARQ) are relevant across Australia, including in the Darwin Region. At smaller scales, there is a need for local information on topics such as:

- WSUD objectives and targets
- Local authority requirements in relation to WSUD
- Selecting appropriate WSUD approaches, allowing site-specific strategies to be prepared for new developments
- Conceptual design of WSUD solutions suitable for the local conditions
- Standard drawings of typical systems that suit local authority requirements
- Construction, maintenance and asset handover processes in the local jurisdiction
- Technical design of systems appropriate for the Darwin Region

Some examples of technical documents are outlined in the following sections.

5.1 Framework Documents

Framework documents provide high-level information on the principles and practice of WSUD and are relevant across Australia. High level goals, outlining more sustainable forms of urban water management, are addressed in framework documents. Framework documents are also comprehensive documents that address the broad spectrum of WSUD including objectives, policy, institutional arrangements and best management practices that are required.

Furthermore framework documents provide the strategic context linking environmental assessment of an aquatic ecosystem and catchment management strategies. They are important in providing the principles and philosophies for coherent and clear sets of objectives and policy. Typically they provide facilitative, supporting, guidelines rather than directive, mandatory, codes.

There are three main national-level framework documents that are relevant to the WSUD Strategy for Darwin Harbour:

1. The National Water Quality Management Strategy
2. The ANZECC Guidelines for Fresh and Marine Water Quality
3. Australian Runoff Quality

The purpose and content of each of these documents is outlined briefly in the following sections.

5.1.1 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) provides a strategic link between environmental values for waterways and catchment management strategies. It outlines a six-step process for an integrated catchment and risk-based assessment:

1. Setting waterway environmental values
2. Identification of threats
3. Identification of management objectives for the catchment
4. Development of catchment management strategies to minimise the identified threats
5. Implementation of the catchment management strategy
6. Performance monitoring and review of the management strategy

The NWQMS has guided the development of the Darwin Harbour Regional Plan of Management, the Draft Stormwater Management Strategy for Darwin Harbour, and other strategic planning documents in the Darwin Region.

5.1.2 ANZECC Guidelines

The ANZECC Guidelines for Fresh and Marine Water Quality provide a framework for water quality management, including setting of water quality objectives. The ANZECC Guidelines include three main components:

1. The designation of environmental values to waterways, and their protection level (protection/restoration/management)
2. The identification of threats/management issues, and key stressors or pollutants associated with each of the categories of threats
3. The identification of water quality trigger levels for water bodies

5.1.3 Australian Runoff Quality

Australian Runoff Quality (ARQ) provides high level guidance on WSUD. An overview of ARQ is shown in Figure 5.

ARQ includes information on:

- Procedures for the estimation of a range of urban stormwater contaminants
- Design guidelines for commonly applied stormwater quantity and quality management practices
- Procedures for the estimation of the performance of these practices

- Advice with respect to the development/consideration of integrated urban water cycle management practices

ARQ also provides an overview of current best practice in the management of urban stormwater in Australia, including techniques for urban water harvesting and reuse as well as stormwater quality. These practices address a range of treatment techniques including wetlands, swales, bioretention systems and infiltration systems.

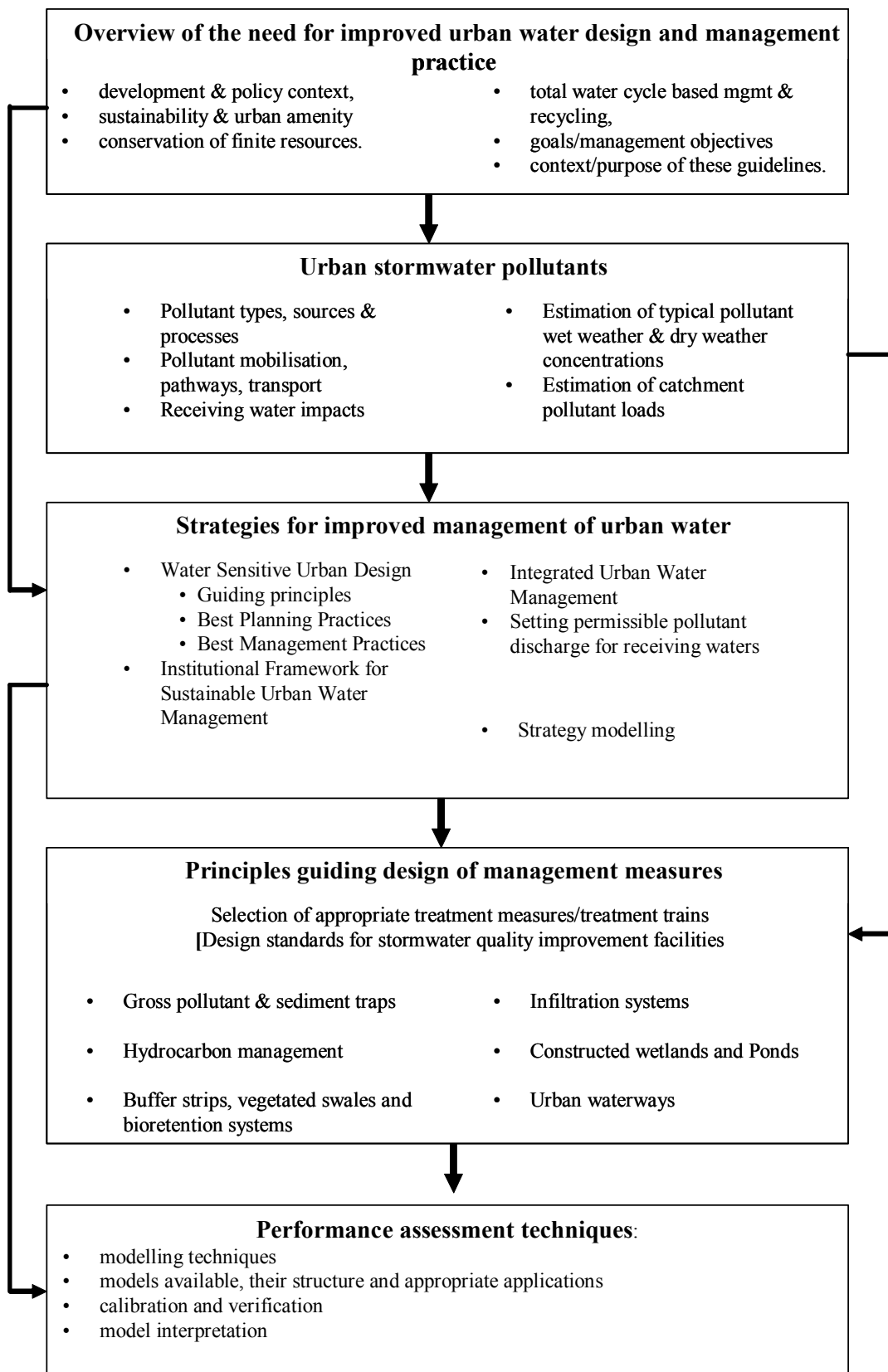


Figure 5 Overview of ARQ

5.2 Planning Guidelines

Planning Guidelines offer high-level advice on management and strategic issues, including:

- Guidance on local planning (e.g. within subcatchments or local government jurisdictions) within the WSUD framework
- WSUD objectives and targets
- Guidance on implementing WSUD at a local level
- Overcoming organisational and other barriers to WSUD implementation
- Engaging with stakeholders on WSUD

To assist local government to develop their strategic position on the adoption of WSUD the NSW Department of Environment and Climate Change (DECC) has prepared and is currently updating the Managing Urban Stormwater (MUS) Framework. The MUS Framework is a holistic suite of guidance documents and supporting “tools” aimed at delivering strategic structural and non-structural responses from regional and local planning authorities in relation to sustainable management of urban stormwater. The MUS framework encapsulates the full hierarchy of guidance documents from high level management considerations through to detailed guidance for both the urban design and detailed technical design and implementation of WSUD techniques for both the construction and post-construction phases of urban development.

An outline of the MUS framework is shown in Figure 3. This figure is colour coded to show the range of documents from high level planning guidelines to technical:

- Planning Guidelines are shown in dark green
- Multi-disciplinary conceptual design information is shown in light green
- Technical design guidelines are shown in yellow

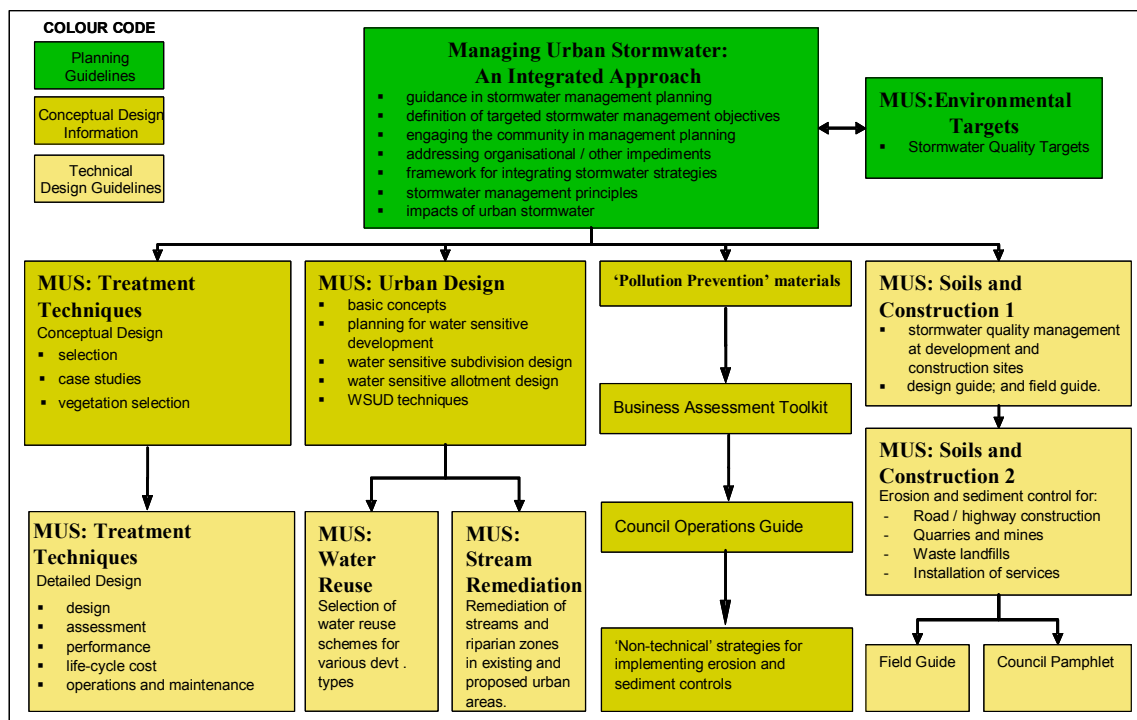


Figure 6: The Managing Urban Stormwater documents and tools (draft framework, 2007)

5.3 Multi-Disciplinary Conceptual Design Information

Conceptual design information is required for a broad non-technical audience. This audience includes catchment managers, local government planners, land developers and their consultants. This audience has multiple needs, but the main focus is on implementation of WSUD at local and site-specific levels. WSUD objectives and targets need to be translated into practical strategies that can be implemented in local catchments and new land developments.

Due to the broad audience, the information that is presented in these guidelines and tools needs to have sufficient detail to meet each user's needs, but at the same time needs to be sufficiently non-technical so that different practitioners can utilise, interpret and build on the information.

Some examples of multi-disciplinary conceptual design information are the locally relevant guidelines that have been prepared by local councils in other states. For example Gold Coast City Council in Queensland has recently prepared a set of WSUD guidelines (http://www.goldcoast.qld.gov.au/t_standard2.aspx?pid=6866) and Wyong Council in NSW are currently preparing a set of guidelines and tools. Wyong's guidelines and tools are outlined in a "Road Map", a draft of which is shown in Figure 7.

Wyong's Road Map in Figure 7 shows:

- Multi-disciplinary conceptual design information in light green:
 - The Development Control Plan (DCP) and Development Assessment (DA) Guide outline council requirements in relation to WSUD, including the WSUD objectives and targets
 - The Site Assessment Guide explains key site attributes (e.g. soil, landscape and vegetation conditions) that affect the selection of an appropriate WSUD approach
 - The Device Selection Guide, Concept Design Tools and Vegetation Selection Guide provide information on the conceptual design of WSUD solutions suitable for the local conditions, including device selection, sizing and performance assessment
- Technical design guidelines in yellow:
 - The Construction Certificate (CC) Guide includes information on utilising the SEQ WSUD Technical Design Guidelines for detailed design in the local context
- Council is considering the preparation of two other tools (shown in light grey text in):
 - Standard drawings of typical systems, which could be used by small developers to expedite the design process
 - A standard construction, maintenance and asset handover process, to facilitate the reliable implementation of these steps

The guidelines and tools being prepared by Wyong Council are largely intended for developers and their consultants to implement WSUD.

WYONG COUNCIL WSUD Strategy Road Map

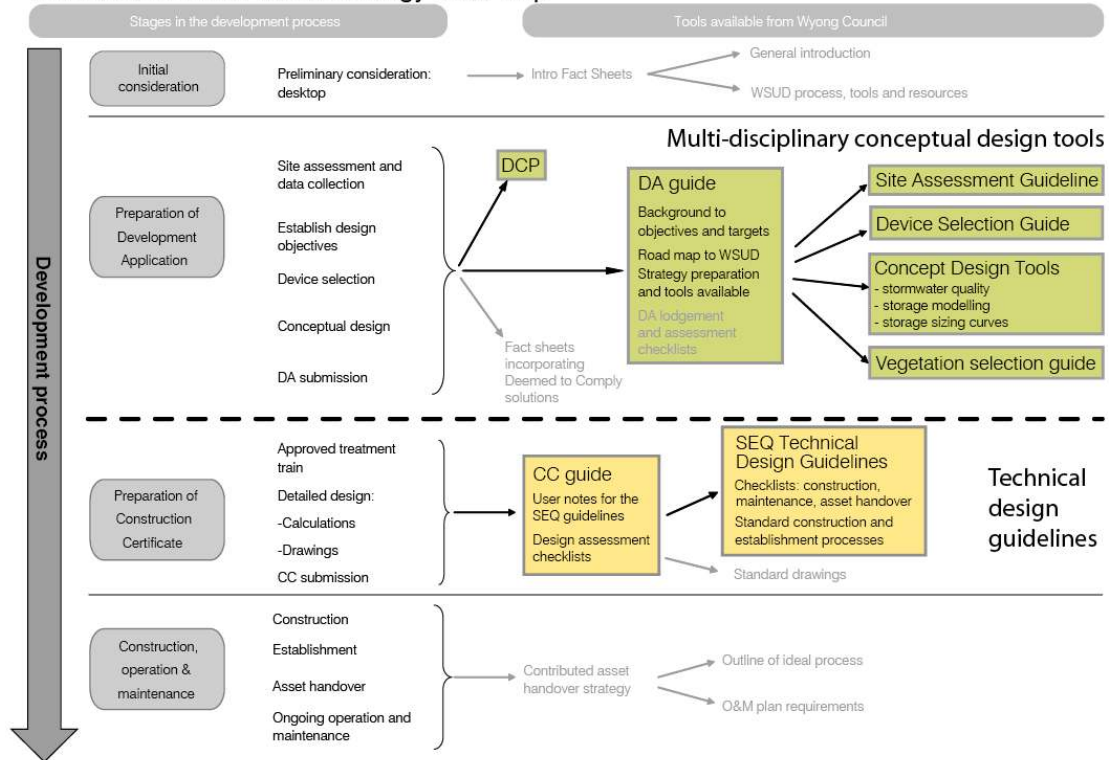


Figure 7: WSUD Guidelines and Tools currently being prepared by Wyong Council for the implementation of WSUD in new developments

5.4 Technical Design Guidelines

Technical design tools are required for those practitioners who are engaged in the detailed design of WSUD elements (including stormwater treatment measures, water saving/alternative water supply measures, waterway restoration and other aspects). They provide specific advice on:

- The design process
- Key design parameters
- Step-by-step design procedures
- Design tools available
- Key design considerations, such as safety considerations
- Construction and maintenance considerations that influence the design process

The *WSUD Technical Design Guidelines for South East Queensland* (Moreton Bay Waterways and Catchments Partnership 2006) are available online:

http://www.healthywaterways.org/wsud_technical_design_guidelines.html

Design Guidelines are intended for a technical audience and enable detailed design of WSUD elements. The focus in the SEQ guidelines is stormwater treatment, however technical guidelines could also include design information for other purposes, e.g. flow management techniques.

The *WSUD Technical Design Guidelines for South East Queensland* provide design guidance for a numerous WSUD measures with individual chapters of the SEQ Guidelines dedicated to each measure as listed below:

1. Introduction
2. Swales (incorporating Buffer Strips)
3. Bioretention Swales
4. Sediment Basins
5. Bioretention Basins
6. Constructed Stormwater Wetlands
7. Infiltration Measures
8. Sand Filters
9. Aquifer Storage and Recovery
10. Plant Selection for WSUD Systems

Chapters 2-8 are organised into the following main headings (not all headings are included in each section):

- Introduction
- Design considerations
- Design process
- Landscape design notes
- Construction and establishment
- Maintenance requirements
- Checking tools
- Engineering drawings and standards
- Worked example
- References and additional information

The SEQ guidelines include checklists for design assessment, construction inspection, maintenance and asset transfer.

6 DECISION-SUPPORT TOOLS

Decision support tools can include a wide range of tools, from a simple multi-criteria analysis tool to a complex predictive model. In the context of the WSUD Strategy for Darwin Harbour, it is intended to develop a predictive model as a decision support tool, and therefore this section focuses on these types of tools.

Predictive models are developed on an understanding of environmental properties and processes. They are used to synthesise our understanding of complex environmental systems and predict the behaviour of the system. In the context of WSUD, they can include both a catchment model, to simulate processes within the catchment, and a receiving water model, to simulate processes within the receiving water body. A combined catchment and receiving water model allows conditions in the receiving water body to be predicted after a change in catchment conditions. Thus, catchment and receiving water models can demonstrate the impact of different catchment management scenarios on water quality in the receiving water body.

Catchment - receiving water predictive models underpin WSUD practices by relating policy, objectives, and technical objectives to the protection of environmental and use values in receiving waters. These tools are required to ensure that management actions are grounded in the best available scientific knowledge of complex environmental systems.

In particular, catchment - receiving water predictive models are useful to:

- Identify risks to water quality in aquatic ecosystems
- Manage threats to environmental and use values of water bodies
- Determine sustainable loads and to set achievable environmental targets for waterway management
- Predict the impact of future management practices
- Assess the impact of modified catchment conditions on receiving water body health
- Evaluate the effectiveness of actions which are being carried out to improve conditions in the receiving water body and protect environmental and use values

This type of decision support tool also assists in compiling information from complex systems in a uniform and strategic manner in order to manage the complexity. Decision support tools are able to:

- Integrate existing data sets and reports
- Document in a transparent way the data and assumptions available for making decisions
- Prioritise key knowledge gaps through open documentation of data used in the model and analysis of the implications of any uncertainty in this data for decision making

The following sections outline some examples of the use of predictive models as decision support tools for WSUD in South East Queensland, New South Wales and Victoria.

6.1 South East Queensland

A good example of predictive model decision support tools are those used in South East Queensland, which have been developed through the Moreton Bay Waterways and Catchment Partnership. These decision support tools determine the response of aquatic receiving environments to changes in catchment conditions. Catchment models, incorporating catchment activities and loads, are linked to receiving water quality models. The decision support tools in use in SEQ include:

- A set of catchment models - The Environmental Management Support System (EMSS)

- A set of receiving water quality models - The Receiving Water Quality Model (RWQM)

A conceptual framework that illustrates these models is shown in Figure 8.

The EMSS estimates daily runoff and pollutant loads from 175 catchments in the SEQ region (23,000 km²) and the storage and transport of runoff and pollutant loads to the receiving waters. The main use of EMSS is to estimate present runoff and pollutant loads and to assess the impact of changes in land use and land management practices on runoff and pollutant export loads. A “Local” EMSS also exists for the Pine Rivers region.

The RWQM is a detailed model of Moreton Bay, which represents the physical, chemical and biological processes occurring within the Bay. This model can be used to test the impacts of various management scenarios on the processes in the Bay. Chlorophyll and suspended sediment are used as water quality indicators for the management scenarios.

A key concern with the use of numerically based computer process models is their accuracy and validity. To ensure that the models are valid to run different scenarios for the SEQ Healthy Waterways Strategy, the models have been calibrated and validated using monitoring data as well as undergoing external peer reviews conducted by CSIRO.

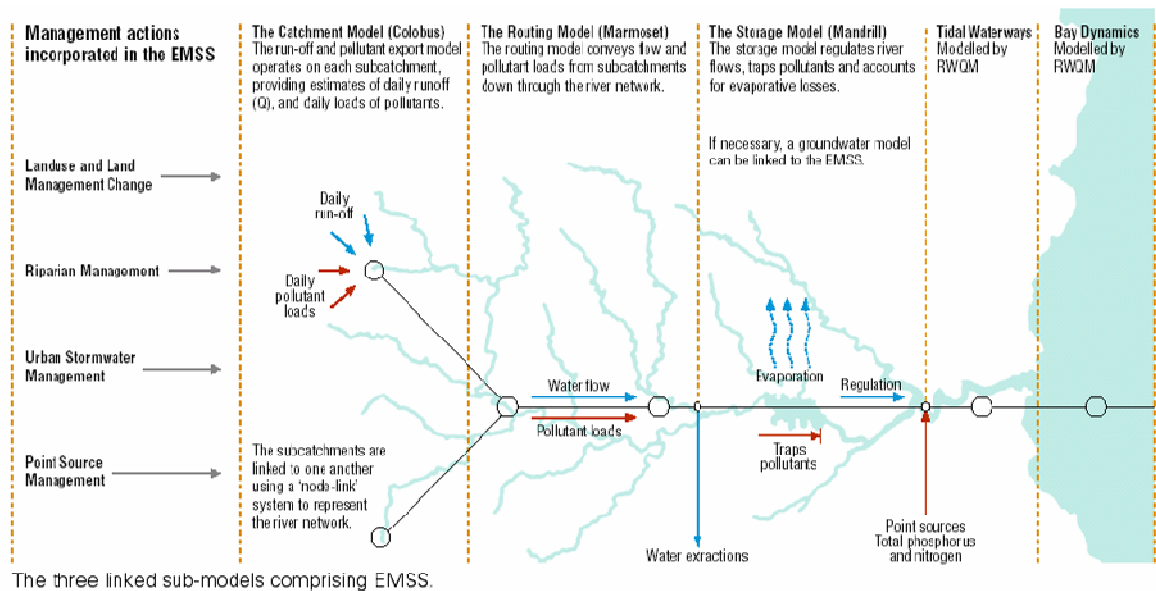


Figure 8: Relationship between SEQ Decision Support Tools

6.2 Victoria

Various predictive model decision support tools for Port Phillip Bay have been developed and adopted over time, including Krakatoa, FILTER and YarraSIM. These tools have provided a range of both complexity and scale of coverage, and have been used to address various management issues over the past decade (Argent et al, 2007).

Currently a predictive model decision support tool is being developed for the “Better Bays and Waterways” program. This program is a partnership involving EPA Victoria, Melbourne Water and the Department of Environment, Water, Heritage and the Arts which receives funding from the Coastal Catchments Initiative.

This predictive model, named PortsE2, has 189 sub-catchments, with a network that supports sub-catchment and basin scale load estimation. Major water storages and the dominant flow control structures, including diversions, are included in the model. Climate data has been selected to choose a dry, average and wet year. Five land cover groups were used to support regionalised flow calibration. Water quality (TN, TSS, TP, pathogen and toxicant) parameters were obtained from field data and literature. Water quality was generally modelled using an event mean

concentration / dry weather concentration (EMC/DWC) approach, with selection of parameters based upon a combination of monitoring data and values from literature.

PortsE2 has been used to model a range of scenarios, such as land use change adoption of best management practices. In general, PortsE2 provides relevant information on possible changes to constituent loads and allows comparison of the effects of different combinations of actions.

One of the key approaches the model development of PortsE2 was the use of a working group in a decision making role. The working group had representatives from major organisations with a stake in catchment management, including

- Melbourne Water (MW)
- Victorian State Government Departments
- Catchment Management Authorities

The working group took an active role in identification and specification of sub-catchments, grouping and characterisation of land uses, selection of constituents to be modelled, and representation of climate variability through development of a default scenario encompassing possible dry, wet, and 'average' conditions (Argent, et al, 2007).

One of the key findings during the development of PortsE2 was that in some domains there is a lack of relevant data and knowledge, particularly in relation to agricultural land use and the scaleability of mitigation impacts. In general, however PortsE2 was found to provide a robust platform for development of a catchment - receiving water predictive model to meet the needs of a working group with a broad range of stakeholders (Argent, et al, 2007).

6.3 New South Wales

The development of decision support tools in New South Wales has been driven through the development of tools for managing coastal lakes.

The Coastal Lake Assessment and Management (CLAM) model was developed to assist in carrying out sustainability assessments for coastal lakes. CLAM incorporates probability estimates into its model scenarios, which allows the model to quantify the uncertainty in the results. This approach is suitable for projects in which there is a combination of high quality data and uncertain qualitative information.

The NSW approach for coastal lakes was to develop a sustainable-loads model, which allows councils, planners and catchment managers to understand and quantify the relationship between changed catchment conditions and ecological response.

As an example of its application, CLAM was used to model a number of urban development scenarios on Lake Macquarie. Various urban development scenarios and the associated nutrient loads were modelled for their impact on the abundance of aquatic plants and nuisance algal blooms.

The NSW Government has also developed a predictive model decision support tool for inland catchments. In the Ben Chifley Dam catchment a predictive model was developed to help water quality managers in their decision-making. The project measured the input of nutrients from different parts of the catchment into the reservoir, how they moved within the water storage, and the main factors which stimulate problem algal blooms.

Mitigation options can be modelled at different scales (individual river reach or sub-catchment) to determine where pollutants are generated and transported. The NSW Government is currently expanding the use of the Ben Chifley Dam decision support tool in other NSW catchments.

7 WSUD PROGRAMMES

Policy instruments and technical guidelines and tools are only effective when accompanied by effective programmes to support their adoption. Within each state there are a range of worthwhile programmes being used to help implement WSUD policy. Key examples are described in each section below.

7.1 South East Queensland

The SEQ Healthy Waterways Partnership (formerly the Moreton Bay Waterways and Catchments Partnership) is a special collaboration between government, industry, researchers and the community. The purpose of the Healthy Waterways Partnership is to improve catchment management and waterway health in South East Queensland. Their role includes support for the implementation of WSUD.

The Healthy Waterways Partnership brings together a range of different stakeholders and encompasses a range of activities:

- The SEQ Healthy Waterways Strategy 2007-2012 was prepared by the Partnership in 2007 and incorporates several Action Plans
- A science and research programme is conducted by the Partnership to provide independent scientific advice, including decision support tools
- The Ecosystem Health Monitoring Program (EHMP) delivers a regional assessment of the ambient ecosystem health for each of SEQ's 18 major catchments, 18 river estuaries, and Moreton Bay, highlighting where the health of each waterway is getting better or worse
- WSUD is supported through the "Water by Design" programme, which includes:
 - A Strategy for WSUD (incorporated within the SEQ Healthy Waterways Strategy as the "WSUD Action Plan")
 - WSUD Technical Design Guidelines and Fact Sheets
 - A "WSUD Information exchange" (online directory to relevant information)
 - WSUD training and other events
 - An e-group, who receive newsletters and other information
 - WSUD case study information

These activities support the mainstream adoption of WSUD in SEQ. Further information can be found on the Health Waterways Partnership website: <http://www.healthywaterways.org/index.html>

7.2 Victoria

In Victoria, Melbourne Water plays a key role in implementation of WSUD in the Melbourne metropolitan area. Melbourne Water's programmes to support WSUD include:

- The Melbourne Water Stormwater Program which has been funded through the Yarra Action Plan which identifies stormwater as the most significant source of pollution in the city's rivers creeks and wetlands. The \$20 million Stormwater Program seeks to tackle diffuse stormwater pollution, and increase institutional capacity at a local level. The Program includes a specific of \$10 million for the four councils of the Lower Yarra Catchment.
- **Clearwater**: an information exchange including links to:
 - Training courses

- Resources including other websites, reports, case studies, guidelines and other publications
- A discussion forum providing advice and referrals
- A **WSUD website** with an on-line guide to WSUD implantation, as well as links to guidelines, tools, fact sheets, education and other information

Melbourne Water's WSUD website, including a link to the Clearwater website, can be accessed at <http://wsud.melbournewater.com.au/>

7.3 New South Wales

In Sydney, the "WSUD in the Sydney Region" programme operates to assist local councils with the implementation of WSUD practices. The Sydney Region programme is a collaborative effort between a number of state and local government agencies and its principal aim is to enhance the ability and willingness of local councils to implement more sustainable water management practices.

Key components of the programme include:

- The **Sustainable Water Challenge** - an annual competition for council projects dealing with sustainable water management.
- Publications including:
 - The **WSUD Planning Guide and Practice Notes** - a series of publications to assist councils incorporate WSUD into their local planning provisions, also discussed under Section 4.4
 - **WSUD Technical Guidelines for Western Sydney** - a detailed design guideline for WSUD in Western Sydney
- **Seminars, workshops and site visits** are run regularly to involve council staff
- The programme's website includes an **information exchange** with links to relevant literature, as well as a section where councils can share information on their projects
- An **image library** that councils can use to prepare presentations and documents for councillors, senior management staff and the community

The WSUD in the Sydney Region website can be accessed at: <http://www.wsud.org/index.htm>

8 FRAMEWORK FOR WSUD IN DARWIN HARBOUR

A conceptual framework for WSUD in the Darwin Harbour Catchment has been developed to address WSUD in both new and existing developments, as well as providing an overall framework for WSUD (Figure 9). The framework illustrates how the overarching WSUD strategy encompasses both existing development and new developments and how these tasks relate to the various stages.

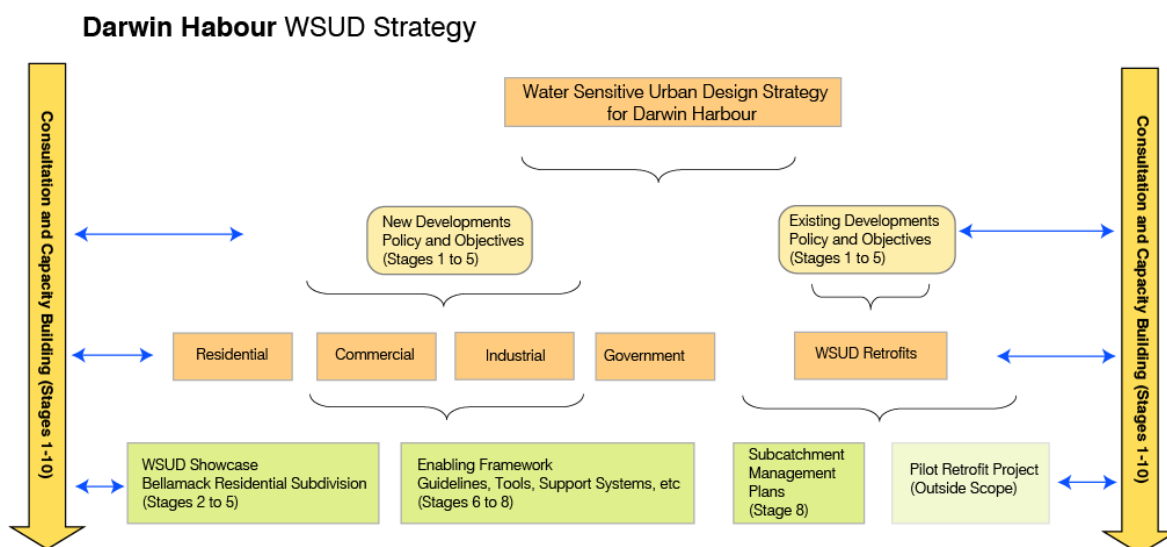


Figure 9 Broad Framework

The major goal of the WSUD Strategy for Darwin Harbour is the adoption of WSUD in all new development in the region. The three key overall phases of implementing the WSUD Strategy for new developments are:

- setting and adopting WSUD Objectives
- development of an enabling framework
- industry and whole of government communication and capacity building

These phases are discussed in more detail in the following sections

8.1.1 Setting and Adopting WSUD Objectives

Setting WSUD objectives for new development and the adoption of these objectives into policy and legislation. Currently Interim Objectives have been developed in the early stages of this project. The next stage of this project will seek stakeholder agreement on these interim objectives and determine the most appropriate way of adopting these interim objectives into policy and legislation in the local context. Task that will be required to implement the WSUD objectives include:

1. Further development of technical and economic feasibility of waterway objectives
2. Further development of an appropriate water conservation target and the technical and economic feasibility. This task involves an analysis of current water consumption data, the potential of demand management measures to reduce water consumption and the feasibility of non-potable water supplies such as rainwater tanks, aquifer storage and reuse and wastewater reuse.
3. Further development of the water quality targets and their application to various developments including industrial developments, high density urban residential developments and various government developments.
4. Whole of Government engagement strategy to support adoption of WSUD objectives

5. Analysis of existing legislation and policies in relation to its current support and potential modification to incorporate WSUD objectives
6. Incorporation of WSUD objectives into existing legislation and policy

This phase of the project broadly encompasses Stages 1 to 5 outlined in Table 1.

8.1.2 Enabling Framework

Development of a broad enabling framework including, guidelines and tools to assist new development implement the WSUD principles and meet the objectives developed in section 8.1.1. This phase of the project broadly encompasses Stages 6 to 8 outlined in Table 1.

8.1.3 Communication and Capacity Building

Communication and capacity building is the principal component of the final phase of the project. Capacity building, consultation and communication is integrated throughout the project there is a significant increase in capacity building in the latter phase to ensure widespread adoption of the WSUD strategy.

A series of formalised workshops and training sessions are proposed to disseminate information to a broader audience. This includes

- the training of local Council and Territory government staff.
- Industry training for practitioners of WSUD, primarily those responsible for the implementation of WSUD which includes government engineers and ecologists, consultants and Utility companies.

The training will form an important element of the dissemination and roll-out of the implementation guidelines and tools. A training program will be developed to ensure knowledge transfer and application of the WSUD objectives, guidelines and tools. The training workshops will be interactive with participants, involving problem based learning, through training modules, whereby the implementation strategies suggested can be trialled by staff.

The training modules will be developed through consultation with government and involve appropriate groups based on the type of activities and skill levels. These different groupings will involve different types of training and are likely to include:

- senior managers and developers (information),
- planning and assessment officers (assessment and compliance processes),
- operation and maintenance staff (ensuring efficient maintenance), and
- stormwater / engineering managers and designers (design and application of WSUD and water recycling, harvesting technologies).

For more information on the communication and stakeholder engagement strategy see the WSUD Communication and Consultation Strategy developed for the program. This phase of the project broadly encompasses Stages 9 to 10 outlined in Table 1.

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